# MODELLING COLOUR AND FIRMNESS CHANGES OF STORED TOMATOES (*LYCOPERSICUM ESCULENTUM* L.) AT DIFFERENT CONDITIONS

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## OBJECTIVE

Evaluate tomatoes colour and firmness development, stored at different temperatures (2º, 5º, 10º, 15º and 20º C), and determine the kinetic parameters of these quality attributes changes, for a better understanding of temperature and storage time effects.

## INTRODUCTION

Tomatoes colour is the first external characteristic that determines the degree of consumer acceptance. Important colour changes occur at various stages of tomatoes development, in terms of chlorophyll (green), lycopene (red) and β-carotene (orange) contents [1].

Firmness is another important tomato quality attribute, and may be the final index by which the consumer decides to purchase tomatoes, using the "finger to test" tomato firmness at the time of selection [2]. During post-harvest it is extremely necessary to apply treatments that promote ripening control to extend fruits shelf-life [3], being refrigerated storage the most widely used method.

## MATERIAL AND METHODS

**I. Tomatoes**

(cv. Zinac, mature green stage)

**Table 1 –** Initial values of tomato quality attributes.

| Quality attributes | | |
|---|---|---|
| Colour | L* | 51.04 ± 4.10 |
| | a* | -10.71± 0.42 |
| | b* | 22.21 ± 3.13 |
| | hue (ºh) | 110.67 ± 3.36 |
| Firmness | Maximum force (N) | 10.98 ± 1.47 |
| Total phenolics content | (mGAE.100g$^{-1}$) | 25.36 ± 1.59 |
| Titratable acidity | (g citric acid.100g$^{-1}$) | 0.59 ± 0.03 |
| pH | | 4.22 ± 0.02 |
| Solids soluble content | ºBrix | 4.43 ± 0.05 |

**II. Storage**

(2º, 5º, 10º, 15º and 20ºC at 90% RH)

**III. Evaluation**

❑ Colour ((Minolta Chroma meter, CIELab parameters), 16 determinations;

Fig. 1 – Minolta CR -300

❑ Firmness (Texture Analyzer, 50 N load cell, cylinder probe with a diameter of 2 mm, 3 mm.s$^{-1}$ of speed and at 7.5 mm of distance penetration, 16 determinations.

Fig. 2 – TA-HDi Texture Analyser

### Kinetic parameters

The development of tomatoes colour (a* and ºh colour parameters) and firmness (maximum force) was described by the fractional conversion kinetic model (Equation 1) and the reaction rate temperature dependence followed the Arrhenius behaviour (Equation 2).

$$\frac{C - C_e}{C_0 - C_e} = e^{-kt} \quad \textbf{(Equation 1)}$$

$$k = k_{ref}\, e^{\left[-\frac{Ea}{R}\left(\frac{1}{T}-\frac{1}{T_{ref}}\right)\right]} \quad \textbf{(Equation 2)}$$

### Data analysis

The temperature and storage time effects were analyzed using Statistic v.7.0 Software (StatSoft, Inc., 2004). The differences between samples were detected through Scheffé test (significant at $p < 0.05$).

## RESULTS AND DISCUSSION

Fig. 3 and 4 show tomatoes a*. ºh and firmness development during storage.

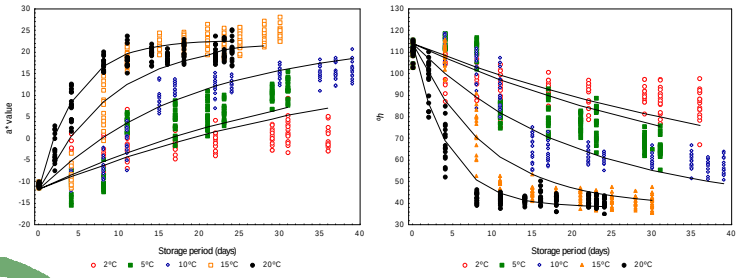


**Fig. 3 –** Tomatoes a* and ºh colour parameters as a function of temperature and storage time. The lines represent models fits to experimental data.

The a* increased and ºh decreased significantly ($p<0.05$) during storage at all temperatures, and tomatoes become more red with time and temperature increase.

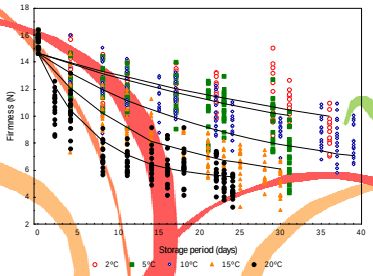


**Fig. 4 –** Tomatoes firmness (N) as a function of temperature and storage time. The lines represent models fits to experimental data.

Tomatoes firmness decreased significantly ($p<0.05$) during storage at all temperatures.

At lower temperatures (2º and 5ºC) the decrease was minimal when compared to the higher ones (10º, 15º and 20ºC).

Table 2 shows the estimated kinetic parameters of tomatoes quality attributes.

**Table 2 –** Kinetic parameters and corresponding confidence intervals at 95% of the colour parameters (a* and ºh) and firmness during storage.

| Quality attributes | | |
|---|---|---|
| Colour | a* | $C_0$ = -11.80± 0.71<br>$C_e$ = 22.71 ± 0.81<br>$k_{20ºC}$ = 0.22± 0.02 day$^{-1}$<br>Ea = 97.01± 4.50 kJ.mol$^{-1}$<br>$R^2$=0.94 |
| | hue (ºh) | $C_0$ = 113.93± 1.53<br>$C_e$ = 38.10 ± 1.81<br>$k_{20ºC}$ = 0.22± 0.02 day$^{-1}$<br>Ea = 103.38± 4.69 kJ.mol$^{-1}$<br>$R^2$=0.94 |
| Firmness | Maximum Force (N) | $C_0$ = 13.73± 0.27<br>$C_e$ = 4.81 ± 0.74<br>$k_{20ºC}$ = 0.08± 0.02 day$^{-1}$<br>Ea = 60.27± 6.31 kJ.mol$^{-1}$<br>$R^2$=0.84 |

The high activation energy of hue colour (Ea = 103.38± 4.69 kJ.mol$^{-1}$) results on greater sensitivity to storage temperature, while firmness (Ea = 60.27± 6.31 kJ.mol$^{-1}$) was the less sensitive quality attribute.

## CONCLUSIONS

The results were modelled by a fractional conversion kinetic equation, which allows the description and simulation of the tomatoes quality attributes behaviour as a function of storage temperature and time. To extend tomato shelf-life, low storage temperature is recommended.

References:
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Acknowledgements:
The author Joaquina Pinheiro would like to thank Fundação para a Ciência e a Tecnologia (PhD grant SFRH/BD/24913/2005).